

CLAIMS:

1. A system for modifying a time-base of a digital video stream; the system including an encoding device and a storage device connected via a digital video communication system, and a decoder/renderer;

the encoding device including:

5 an input for receiving an input video signal, and an input frame signal (vsync) synchronous to and indicating frame boundaries in the input video signal;

an encoder for converting the input video signal and input frame signal to a corresponding digital video stream complying with a predetermined video encoding standard; the encoder including a encoder clock complying with the video encoding standard; the digital video stream including: a sequence of digital video frames corresponding to received input video frames; a sequence of program clock reference stamps (PCR) representing a clock signal of the encoder clock; and a sequence of video presentation time stamps (PTS) each associated with a respective digital video frame and representing a value of a counter driven by the clock signal at a moment of receipt of an input video frame that corresponds to the digital video frame; and

15 an output for providing the digital video stream via the digital video communication system;

the storage device including:

20 an input for receiving the digital video stream via the digital video communication system;

a time-base modifier operative to:

replace the video presentation time stamps (PTS) by respective modified video presentation time stamps (M-PTS) based on a constant predetermined frame-time between successive presentation time stamps;

25 replace the program clock reference stamps (PCR) by respective modified program clock reference stamps (M-PCR) by scaling the program clock reference stamps (PCR) using a scaling factor that depends on a ratio of an expected time between a video presentation time stamp j and a preceding video presentation time stamp $j-n$ and an actual time between the video presentation time stamp j and the preceding video

presentation time stamp $j-n$, where $j \geq n > 0$, and the expected time is n times the predetermined frame time;

a storage for storing at least a part of the time-base modified video stream; and
an output for providing a video stream from the storage device to the

5 decoder/renderer; and

the decoder/renderer including an input for receiving a video stream from the storage device and being operative to decode the video stream received from the storage device to enable rendering of the digital video frames in the stream synchronous with the respective associated modified video presentation time stamps.

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2. A system as claimed in claim 1, wherein the time-base modifier includes a clock unit operative to generate a clock signal locked to the received video presentation time stamps (PTS) using an error signal that depends on the scaling factor; the time-base modifier being operative to obtain the modified program clock reference stamps (M-PCR) by sampling
15 a counter driven by the clock signal at a moment of receipt of the program clock reference (PCR).

3. A system as claimed in claim 2, wherein the time-base modifier is operative to low-pass filter the received video presentation time stamps and the clock unit is locked to the
20 filtered video presentation time stamps.

4. A system as claimed in claim 2, wherein the time-base modifier is operative to low-pass filter the scaling factor.

25 5. A system as claimed in claim 1, wherein the digital video stream includes information on a nominal frame rate of the video signal and the time-base modifier is operative to derive the predetermined frame time from the digital video stream.

30 6. A system as claimed in claim 1, wherein the input of the encoding device is operative to receive an analog audio signal; the encoding device further including a sampler for sampling the received analog audio signal under control of a sampling clock signal that is derived from the video input signal and locked onto the input frame signal (vsync); and wherein the encoder is operative to convert the sampled audio signal into a time sequence of

corresponding audio frames and insert the audio frames and respective audio presentation time stamps (A-PTS) in the digital video signal stream.

7. A system as claimed in claim 6, wherein the time-base modifier is operative to
5 replace the audio presentation time stamps (A-PTS) by modified audio presentation time stamps (MA-PTS) by scaling the audio presentation time stamps (A-PTS) using the scaling factor.
8. A system as claimed in claim 1, wherein the storage device is operative to time
10 stamp each packet of the digital video stream on receipt of the packet; to store each time stamp in the storage in association with the corresponding received packet; and to output packets of the stored stream according to the respective time stamps and a predetermined delay.
9. A system as claimed in claim 8, wherein the storage device includes a clock
15 for providing timing signals and the storage device being operative to use as the time stamps stored in the storage the timing signal scaled using the scaling factor.
10. A system as claimed in claims 2 and 9, wherein the storage device is operative
20 to use as the time stamps stored in the storage a counter value from a counter driven by the clock signal locked to the received video presentation time stamps (PTS).
11. A system as claimed in claim 1, wherein the video encoding standard is
25 MPEG2.
12. A system as claimed in claim 1, wherein the digital video communication
system includes an isochronous communication channel for transferring the digital video stream.
13. A storage device for use in a system as claimed in claim 1; the storage device
30 including:
an input for receiving a digital video stream complying with a predetermined video encoding standard via a digital video communication system; the digital video stream including: a sequence of digital video frames; a sequence of program clock reference stamps

(PCR) representing a clock signal of an encoder clock; and a sequence of video presentation time stamps (PTS) each associated with a respective digital video frame;

a time-base modifier operative to:

replace the video presentation time stamps (PTS) by respective
 5 modified video presentation time stamps (M-PTS) based on a constant predetermined frame time between successive presentation time stamps; and

replace the program clock reference stamps (PCR) by respective
 modified program clock reference stamps (M-PCR) by scaling the program clock reference
 stamps (PCR) using a scaling factor that depends on a ratio of an expected time between a
 10 video presentation time stamp j and a preceding video presentation time stamp $j-n$ and an
 actual time between the video presentation time stamp j and the preceding video presentation
 time stamp $j-n$, where $j \geq n > 0$, and the expected time is n times the predetermined frame time;

a storage for storing at least a part of the time-base modified video stream; and
 an output for providing a video stream from the storage device.

14. A time-base modifier for use in a storage device as claimed in claim 13, a
 time-base modifier operative to replace, in a digital video stream that includes a sequence of
 digital video frames, a sequence of program clock reference stamps (PCR) representing a
 clock signal of an encoder clock, and a sequence of video presentation time stamps (PTS)
 20 each associated with a respective digital video frame, the video presentation time stamps
 (PTS) by respective modified video presentation time stamps (M-PTS) based on a constant
 predetermined frame time between successive presentation time stamps and the program
 clock reference stamps (PCR) by respective modified program clock reference stamps (M-
 PCR) by scaling the program clock reference stamps (PCR) using a scaling factor that
 25 depends on a ratio of an expected time between a video presentation time stamp j and a
 preceding video presentation time stamp $j-n$ and an actual time between the video
 presentation time stamp j and the preceding video presentation time stamp $j-n$, where $j \geq n > 0$,
 and the expected time is n times the predetermined frame time.

15. A method of modifying a time-base of a digital video stream that complies
 with a predetermined video encoding standard and includes a sequence of digital video
 frames, a sequence of program clock reference stamps (PCR) representing a clock signal of
 an encoder clock, and a sequence of video presentation time stamps (PTS) each associated
 with a respective digital video frame; the method including:

replacing the video presentation time stamps (PTS) by respective modified video presentation time stamps (M-PTS) based on a constant predetermined frame time between successive presentation time stamps; and

- 5 replacing the program clock reference stamps (PCR) by respective modified program clock reference stamps (M-PCR) by scaling the program clock reference stamps (PCR) using a scaling factor that depends on a ratio of an expected time between a video presentation time stamp j and a preceding video presentation time stamp $j-n$ and an actual time between the video presentation time stamp j and the preceding video presentation time stamp $j-n$, where $j \geq n > 0$, and the expected time is n times the predetermined frame time.

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16. A computer program product operative to cause a processor to perform the method of claim 15.